

# Chapter 3

## Petrozuata - the Relationship between High IRR and Political Risk

### Summary of Conceptual Valuation Errors Made in the Case

Many of the case studies discussed in the remaining chapters of this part of the book use articles published by the Harvard Business School (HBS) on case histories of particular companies. These case studies can be of interest in studying conceptual valuation mistakes because quite a few people may be familiar with the stories from taking courses in business school. But hopefully, the perspective in the analysis of the cases is very different than the business school discussions where management and financial institutions are often applauded. When you attend business school you are supposed to look-up to brilliant managers who have previously earned a degree from your institution and then write-up a case study about their company. In analyzing cases here, the idea is different. The objective involves learning from mistakes in the spirit of Author John Dewey's statement that "Failure is instructive. The person who really thinks learns quite as much from his failures as from his successes."

Most of the cases are not very recent and one may complain that they do not reflect the latest trends in finance and market conditions. But by using cases where the analysis has previously been made and the valuation result is known -- such as large stock price decline, a bankruptcy, debt restructuring or a nationalization -- a review of why the case failed can be evaluated. With hindsight, the implicit or explicit economic assumptions and theories of valuation that were applied when the investment was made can be evaluated. The case in this chapter involves an oil project developed in Venezuela. The company making the investment for this first case was named Petrozuata. The case has been used frequently in business schools as an example of successful application of project finance. In the world of finance, the project was famous for a number of reasons including: (1) it was the largest project financing and project bond offering in Latin America to date; (2) it was able to obtain project credit ratings above

sovereign credit ratings of Venezuela despite oil price risk; (3) at the time of financing, it had the highest credit rating for a project in Latin America; (4) debt on the project had no political risk insurance despite being located in Venezuela; and, (5) bank loans for the project had the longest maturity to date in Latin America.

The discussion of Petrozuata is derived from various different sources that document the financing and the risk analysis of the project. The primary reference is a Harvard Case Study that is also included in the book *Project Finance Case Studies*.<sup>1</sup> Additional sources include an article written by Professor Benjamin Esty titled *Petrozuata: A Case Study in the Effective Use of Project Finance*; *Journal of Applied Corporate Finance*.<sup>2</sup> A third source that is particular to this case is an article titled *Petrozuata, Teaching Note*<sup>3</sup> which is available on the internet. This article provides an insight as to how business school interpret various issues that are supposed to guide discussion of the case and what kind of analysis is taught to students who are soon to enter the world of finance. Other sources include the arbitration cases concerning nationalization of the project and *Project Finance: Practical Case Studies*.<sup>4</sup>

The HBS case study write-up and the associated articles focus on financing of the project and laud the fact that the project finance structure was a breakthrough. Each year various organizations give awards for project finance transactions. This is something akin to academy awards that are selected for films in Hollywood. Presumably, there are award dinners after which bankers like actors give irritating speeches congratulating themselves for innovative transactions. The Petrozuata project finance transaction not only won all of the awards, it was even called the “deal of the decade” and praised for the manner it was able to raise capital and achieve investment grade ratings. But this transaction that was supposed to be such a success ended up in a nationalization for shareholders and a bitter dispute about compensation for Conoco, the American company that made 50.1% of the equity investment in the project. The Petrozuata project was developed in the late 1990’s, completed in 2002 and nationalized five years later in 2007.

This chapter addresses why such a highly praised investment ended up being subject to such problems for the Conoco, the equity investor. Instead of simply blaming political uncertainty and an irrational, out of control politician, Hugo Chavez, analytical issues associated with political risk are addressed. Some

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<sup>1</sup> Case Studies in Project Finance,

<sup>2</sup> Footnote on date of article

<sup>3</sup> Authored by Mathew Millet in 1999.

<sup>4</sup> Project Finance: Practical Case Studies, Second Edition, VOLUME II, Resources and Infrastructure, Henry A. Davis, Euromoney Books, Nestor House, Playhouse Yard, London EC4V 5EX, United Kingdom, Copyright © 2003 Euromoney Institutional Investor PLC

of the flaws in analysis that led to nationalization can be found by stepping back and asking general questions about who deserves economic rent from oil production and how to evaluate political risk. With the benefit of hindsight, valuation errors that were made in the Petrozuata case and arguably ultimately led to its disappointment for equity investors included:

- Not beginning the evaluation of an investment by analysis of the production cost and the cost structure of an investment relative to competing alternatives.
- Using measures of IRR to evaluate the economic profit on project financings and not considering what it really means to earn a high IRR over a long period of time.
- Not correctly measuring political risk and applying an extremely high equity risk premium to the cash flows and not explicitly measuring the probability of expropriation implicit in credit spreads.
- Assumptions that off-shore accounts and partnership structures can reduce or eliminate political risk.
- Applying Monte Carlo simulation does not answer anything about value, risk or debt structure.

## Synopsis of the Case

The HBS case for Petrozuata begins by describing how financial management of the project had a big challenge in finding an optimal mix of financing from different sources. Political and economic problems are then discussed to point out how difficult and expensive the financing would have been had conventional debt issued by state been used. The national oil company of Venezuela named PDVSA, the second largest state-owned oil company in the world, is described. However PDVSA had a very low junk-bond rating of single-B that was driven by the credit rating of risks associated with the country of Venezuela. In the early 1990's Venezuela embarked on a strategy to make investments of \$65 billion in the upstream production industry called "the opening." A PDVSA executive quoted in the case explained that for the company, "the most limited resource ... is money."

Petrozuata was the first of four strategic associations between PDVSA and foreign partners to develop heavy oil. In 1960 Venezuela was a founding member of OPEC and in 1975 it nationalized its oil production limiting private investment. The Petrozuata project and other partnerships that were formed to develop, transport, upgrade and market extra-heavy crude oil from different defined areas in

the Orinoco Belt were allowed by an exception to the 1975 law. The Orinoco Belt, located in Eastern Venezuela and north of the Orinoco River, was largely untapped because of the oil's heavy, high sulfur characteristics, and the lack of infrastructure, markets and investment capital. Deposits in the belt are extra-heavy oil, which is a tar-like substance that acts as a dense liquid underground, but solidifies once brought to the surface. Private investment was permitted by the Venezuela congress in the Orinoco belt through joint venture partnerships with private-sector partners.

Petrozuata was the first of the four Orinoco Belt partnerships to be developed. Each of the projects received tax breaks to encourage the investment that were presumably negotiated by the foreign equity investors. Specifics of the tax breaks are outlined in the arbitration reports. A royalty rate of 16.33% was part of the 1943 hydrocarbons law in Venezuela and this royalty was temporarily reduced, for 9 years, to 1% for the Orinoco Belt projects. In addition, the income tax rate of 67.7% that was applied to other oil projects was reduced to the overall corporate tax rate 34%. Sponsors of the Petrozuata project were a subsidiary of PDVSA named Marven that owned 49.9% and Conoco who owned 51.1%. The oil concession was to last 35 years after which Conoco shares would be given to PDVSA. In the HBS case write-up, Conoco was lauded in the case as being "a leader in the world in both refining technology and project development." The case noted how Conoco had earned the Distinguished Achievement Award from the Offshore Technology Conference.

The project is described by various different sources as consisting of three parts: (1) 530 production wells that apply horizontal rather than vertical drilling; (2) a pipeline system that transports the oil to a port at San Jose; and (3) an upgrading facility to partially refine the heavy crude oil. The HBS case notes that the project has little exploration risk and is termed a development project. The general nature of the project can be seen in Figure 3.1 that displays the sources and uses of funds. A sources and uses analysis is an effective way to paint a picture of the project during from where expenditures are made. The uses and sources statement demonstrates that more than half of the expenditures (60%) are for the upgrader. The estimated oil reserves from the allocated 300 square km area of the Zuata area of the Orinoco Belt of 21.5 billion cover the 120,000 barrel per day capacity of the upgrader by a very wide margin. You can divide 21.5 billion by 35 years and then by 365.25 days to derive potential production from the area. Then you can divide that number by the capacity of the upgrader to derive a margin of 14 times. This simple calculation demonstrates that risks of not producing enough reserves to cover the production of the upgrader was not a serious issue.

	1996	1997	1998	1999	2000	Total
<b>USES</b>						
<b>Capital Expenditures</b>						
Crude Oil Production	\$11,995	\$191,849	\$151,141	\$77,092	\$16,702	\$448,780
Crude Oil Pipeline	655	170,512	45,121	0	0	216,288
Upgrader & Loading Facility <sup>a</sup>	14,345	243,305	510,987	230,306	67,912	1,066,854
Upstream Contingency	0	0	0	0	37,925	37,925
<b>Total Capex</b>	<b>\$26,994</b>	<b>\$605,666</b>	<b>\$707,249</b>	<b>\$307,399</b>	<b>\$122,539</b>	<b>\$1,769,847</b>
<b>Other Costs</b>						
Deferred Development Costs and Operating Expenditures	\$52,040	\$23,328	\$71,724	\$0	\$0	\$147,093
Initial Cash Balance	0	0	10,000	0	0	10,000
Financing Costs	0	61,134	86,816	94,955	111,556	354,461
Legal & Advisory Fees	0	15,000	0	0	0	15,000
Debt Service Reserve	0	0	0	0	80,865	80,865
Excess Cash Balance	0	47,213	0	0	195	47,408
<b>Total Uses</b>	<b>\$79,035</b>	<b>\$752,341</b>	<b>\$875,789</b>	<b>\$402,353</b>	<b>\$315,155</b>	<b>\$2,424,673</b>
<b>SOURCES</b>						
<b>Total Project Debt</b>	<b>\$0</b>	<b>\$1,000,000</b>	<b>\$24,299</b>	<b>\$242,981</b>	<b>\$182,720</b>	<b>\$1,450,000</b>
<b>Shareholder Funds</b>						
Initial Paid in Capital	\$79,035	\$0	\$0	\$0	\$0	\$79,035
Additional Paid-in Capital	0	1,986	550,148	-1,576	-185,047	365,511
Operating Cash Flow <sup>b</sup>	0	47,213	4,484	160,948	317,481	530,126
<b>Total Shareholder Funds</b>	<b>\$79,035</b>	<b>\$49,199</b>	<b>\$554,632</b>	<b>\$159,373</b>	<b>\$132,434</b>	<b>\$974,673</b>
<b>Total Sources</b>	<b>\$79,035</b>	<b>\$1,049,199</b>	<b>\$578,931</b>	<b>\$402,353</b>	<b>\$315,155</b>	<b>\$2,424,673</b>

After explaining the project, the HBS case write-up provides a comprehensive description of the structuring of the Petrozuata project including independent engineering analysis, EPC contracts, construction guarantees, letters of credit, completion tests the off-take contract and other features. The teaching note explains that Petrozuata was an “extremely well crafted deal” and how project finance can “create value ... with skilled execution”. Presumably this means the project was able to effectively manage risk by using contracts to allocate the risk to different parties. In the teaching note, project finance is defined as “a financing of a particular economic unit in which lender is satisfied to look initially to the cash flow of earnings of that economic unit as the sources of funds from which a loan will be repaid and to the assets of the economic unit as collateral for the loan.”<sup>5</sup> This quote demonstrates how finance language makes a relatively simple concept complicated.

An alternative definition of project finance can be derived from thinking about an amorous relationship that has different phases and risks. The relationship project begins with a dating phase which is analogous to the development period in project finance. Here the risks of project failure are high but the expenditures are not great. No third parties are generally involved in paying for dinner dates or permitting cost. If the development proceeds, financial close is achieved where a commitment fee is made to the bank. In the relationship analogy, the engagement

<sup>5</sup> Nevitt, Peter, K., 1983, Project Financing, 4<sup>th</sup> Revised Edition (London: Euromoney Publication, 1983), p.3

is agreed to after a proposal and a commitment fee is made by paying for an engagement ring. After large expenditures for construction (or a wedding ceremony and the first house), the commercial operation date occurs. After this date, risks change a lot. Now the operation of the project must generate enough money to pay back debts as a family must pay off mortgages and obligations related to children. After a few years of operation, the risks of the project may further decrease as there is some history demonstrating the project (marriage) can really work. Eventually, the project just ends (one of the people dies). Figure 3.2 illustrates phases of the Petrozuata project along with the actual and projected oil price.

#### INSERT TIME LINE

To see why Petrozuata was touted as the deal of the decade, you can look at the sources side of the uses and sources statement shown in Figure 3.1 (the statement measures inflows and outflows from financial close to commercial operation). A large chunk of financing from debt, \$1 billion of bonds, occurred just after financial close of the project the project in 1997. Development costs were financed with equity and the sponsors, Conoco and PDVSA put \$550 million into the project a year later. Including the subsequent financing from banks, the percentage of debt contributed relative to the debt and equity contributed was 76%. (There are other ways to compute this number by including the operating cash flow as equity, but it can be argued that the initial operating cash flow came about because of the debt and equity funding.) Much of the HBS case write-up describes issues debt financing of the project including interest rates, the way the debt was to be repaid, interest rates and covenants.

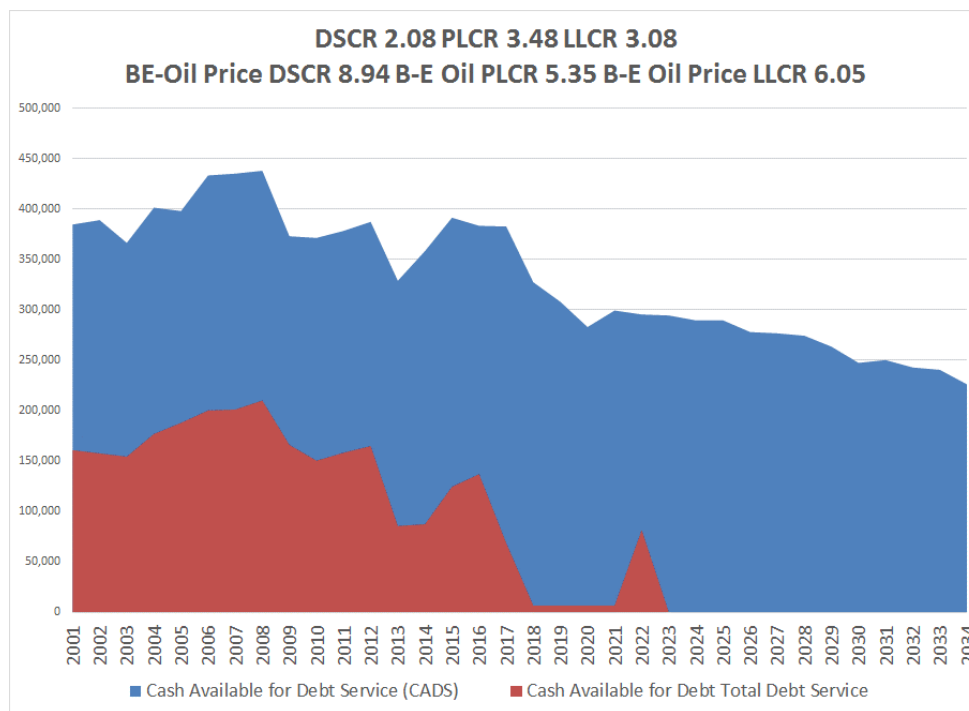
One of the most remarkable parts of the debt financing were the low credit spreads that were achieved on the project. Credit spreads compensate lenders for taking risk and are measured in basis points (100 basis points is 100%). The credit spreads above base interest rates for the bonds and the bank debt were all below 2.3%. This is far below the credit spreads that could have been achieved if PDVSA would have issued its own bonds. The spreads on the bonds were less than the spreads on the bank debt because the bonds were able to achieve an investment grade credit rating. This rating was granted even though no political risk insurance was added to the cost of the bonds or the bank debt. The spreads for bonds and maturities were:

- \$300 million 12-year maturity at 130 over treasuries (7.63%)
- \$625 million 20-year maturity at 145 over treasuries (8.22%)
- \$75 million 25-year bullet bonds at 160 over treasuries (8.73%)

For the bank debt, the maturities were shorter and the interest costs were somewhat higher:

\$200 million 14-year maturity at 220 basis points  
\$250 million 12-year maturity at 208 basis points.

If the sources and uses statement paints a picture of the project during the construction phase of the project, a cash flow and debt service diagram can be made for the project after the construction period. This picture that shows the cash available for debt service and the debt service is presented in Figure 3.3. Risks for the lenders can be seen by looking at the buffer between the cash flow and the debt service as well as the buffer at the end of the debt service period. Even at a low oil price that does not exceed \$18.64 in nominal terms, the project experienced a minimum debt service coverage of 2.08. When measuring the present value of the cash flows relative to the debt service called the PLCR, the coverage was \_\_\_\_.



With the debt structure defined, various risks can be evaluated. Ben Esty's article *Petrozuata: A Case Study in the Effective Use of Project Finance* works through different risks in the project for alternative phases. A risk matrix is presented that demonstrates the only risks taken on by creditors was the possibility of the oil price falling below \$8 for long periods of time and political risk. The article by Esty and the Teaching Note discuss all sorts of ways that political risk was mitigated including: (1) the need for Conoco's expertise; (2) the inability to attract more foreign investment after a nationalization; (3) retaliatory actions by foreign governments; (4) the fact that PDVSA, a government owned entity, is a partner in the project; (5) the ability of Conoco to refine the oil that comes out of

the upgrader (called syncrude); (6) use of off-shore accounts in the cash flow waterfall; and (7) the use of debt leverage. These mitigants are typical of the writing in credit memos where bankers justify to themselves that acceptance of risks is reasonable. The discussion also is used to explain why creeping expropriation through increased taxes would not occur.

To be sure, there are valuable project finance structuring lessons in the case. Without project finance, project may not have been built or would not be feasible because of a high cost of capital. With project finance, risks were put into a closed fence and were able to be quantified without worrying about a host of unknown issues associated with PDVSA that could suddenly appear. However, as stated above problems with the project arose fairly quickly. The time line in Figure 3.4 demonstrates events that led up to the nationalization in 2007. Petrozuata's bonds were repaid, but compensation to equity holders remains a subject of bitter dispute.

## **Valuation Flaw 1: Begin by Understanding the Implications of the Cost Structure and Pre-tax Cash Flows**

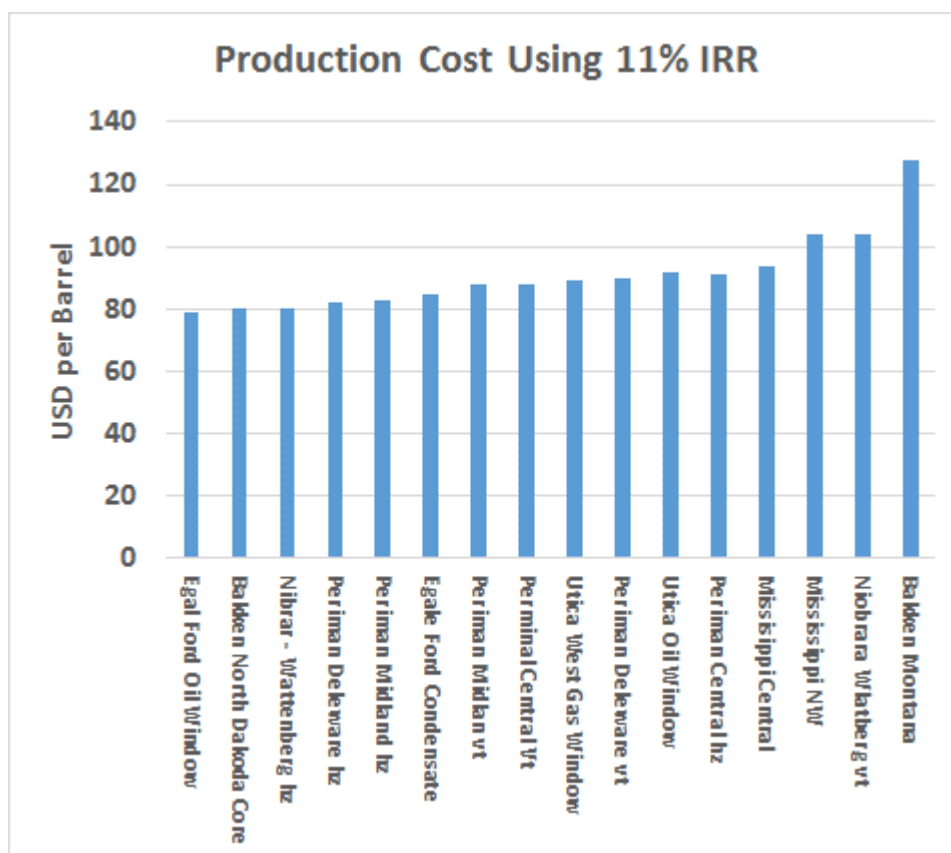
The ultimate issue in the oil industry when it comes to private investment is who gains the economic benefits – the difference between the oil price and the production cost -- for resource that is under the ground. In the U.S., people lucky enough to live above oil fields and private oil companies that explore and develop the reserves receive the economic benefits of the difference between prices and costs. By contrast, Saudi Arabia famously nationalized its industry in the 1970's, a little more than two decades after oil was discovered in 1949 largely by accident. In other countries such as Indonesia and Kasikstan, profits on oil exploration are carefully regulated through production sharing agreements. In analysis of risks and value, the first questions that should have been addressed before all of the project financing structuring analysis and cash flow waterfalls is how much economic rents economic rents were generated for foreign companies that would not be available to people in Venezuela. The Petrozuata project included a foreign investor without sharing or upside or downside risks associated with oil prices. Whether this structure makes sense or whether another structure such as hiring Conoco as a consultant should have been the first question in the case. It was not.

In all of the Petrozuata cases write-ups and other articles there is no mention of the cost of production for the project and there is no computation of the overall return on the project. Production cost of the project including a return on



investment provides a basis to evaluate the economic rents accruing to investors and can be the first step in considering political risk as well as the project economics. The first valuation mistake in the case write-ups is therefore not beginning by asking basic questions involving whether a scenario with low production costs and high profits is logical and sustainable for a foreign investor. This is analogous to the point that for any investment, the starting point should be evaluation of EBITDA, capital expenditures, working capital changes and taxes. These operating cash flows form the basis for evaluating how the cash flow is later split-up. If the operating cash flows produce a rate of return below the interest rate for base case scenarios, the project should not proceed. More specifically, when the project IRR is below the all-in debt cost, the company is not generating sufficient cash flow to cover its cost of capital. A more interesting question arises on the other side of the equation. When the project IRR is very high, questions need to be asked whether the project is too good to be true and what is so special about this project that allows it to.

To demonstrate the usefulness of measuring production costs, consider the issue of whether shale oil and gas production is viable over the long-term. Ignoring the environmental issues associated with shale gas, a fundamental question involves the real production costs of using fracking to produce oil and gas. Shale oil and gas often suggested as a big reason the U.S. was able to recover from the recession of 2008. You can look on the internet and find ranges in production cost for shale oil that vary between \$40 and \$100 per barrel. If the production cost of shale oil is above \$100 per barrel, many of the investments may turn out to be uneconomic and the shale oil boom may be something akin to the housing bubble before the global financial crisis. On the other hand if the production cost is in the range of \$40 per barrel as others suggest, then shale oil does deserve all of the hype. An estimate of production costs made by Goldman Sachs where projects are assumed to earn a return of 11% is displayed in Figure 3.4.



Computing production costs of shale oil challenging because of uncertainty associated with the amount of production that will be generated from capital expenditures made from drilling. The decline curve for reserves is short meaning that new wells must be continually be drilled resulting in what some have called the drilling treadmill. Further, the production generated from new wells could decline as the low hanging fruit is the first to be developed and subsequent projects are less productive. Evidence of high production cost is financial problems of some shale oil investments when the oil price was above \$100 per barrel. For example, Shell oil took a \$2.1 billion write-off of shale oil investments in Texas in 2013. At the time it made shale oil investments Shell expected to produce 250,000 barrels of oil per day.<sup>6</sup> But the company admitted “the production curve is less positive than we originally expected” and it is only producing 50,000 b/d from these properties. While there are many other examples of companies with financial problems during high oil price periods, many company reports suggest the cost of drilling is not very high compared especially

<sup>6</sup> Financial Times, August 1, 2013 “Shell write down is bad news for US shale”, Guy Chazan <http://www.ft.com/cms/s/0/cf41cc36-fab2-11e2-87b9-00144feabdc0.html#ixzz3YM0hydc6>

to deep water alternatives. The reports suggest high IRR's can be earned on drilling even when the oil price is low.

The production cost of Petrozuata can be computed from the capital costs of the upgrader, pipelines and the drilling costs for upstream facilities as well as the operation and maintenance costs and taxes. In computing the capital cost component of production costs, amounts must be levelized and converted to real currency. Cost of money, production, taxes and inflation complicate the calculation. The techniques for computing and evaluating production costs are described at length in Part 4. In addition, a video describing how to compute the costs is included on the associated website. As the mechanical calculations are documented in Part 4, details of the calculation are not repeated here. Compared to the shale oil and gas industry where the key question is the level of production, computing the cost of production for Petrozuata is a relatively straightforward process. Figure 3.5 presents the production costs using different costs of capital and tax rates.

#### INSERT GRAPH OF LEVELIZED COST

Tax breaks were granted to the equity investors in the Orinico Belt projects presumably because the investors maintained that the investment could not be made without the favorable treatment. An odd argument for project finance was presented in the teaching not stating that "Petrozata captures tax benefits that PDVSA cannot....[I]f PDVSA had financed the project internally, it would have been subject to a 67.7% tax rate and a 16.67% royalty rate." As PDVSA is part of the government of Venezuela, the taxes paid by PDVSA are not relevant in considering the production cost.

A fundamental issue that should have been addressed at the outset is whether the structure of allowing foreign firms to gain large profits at the expense of the country where the resources are located. The fact that a large amount of oil can be produced at very low costs raises questions of who should receive the benefits. This fundamental question cannot must be addressed by bankers and equity investors as well as politicians. It is easy to laugh at Hugo Chavez and suggest that this is simply a crazy socialist, but the notion of who really should receive economic profits from natural resources of a country is a fundamental one to all sorts of projects.

## Valuation Flaw 2: Interpreting Value of a Project Finance Investment with High IRR over Long Periods

The teaching note to the case noted that Petrozuata's IRR for the base case is 25.6%. This can be computed by putting the equity outflows next to the inflows in the case write-up and then applying the IRR function in excel. The teaching note later proceeds to discuss a more complex approach called a quasi-market valuation (QMV). (This is nothing more than computing the present value of prospective cash flows but it has a fancy acronym.) Difficulties in interpreting high IRR's that are measured over long-periods is the valuation problem discussed here and in particular, just how much money do projects with high IRR's provide to equity holders. When IRR's are above double digits and cash flow is earned over long periods, the statistics quickly become all but meaningless. The cash to investors when the IRR is high becomes enormous simply because of the mathematics of compound interest and the IRR indicator does not show just how much is being earned. Alternatives to the IRR that measure how much is generated relative to other investments that could be made with the money that is injected into the project.

Over the past couple of decades managers have become more and more enamoured with the equity IRR. In a single statistic you can summarize the entire profitability of a project and compare returns across different projects. For a leveraged buyout that has a single cash outflow and a single cash inflow, the IRR is simply a measure of the compound growth rate on the investment and there is no ambiguity about the statistic. Conoco has asked for \$30 billion from the country of Venezuela as compensation for its investment in the arbitration process. When this cash inflow is compared to half of the \$500 million equity investment made in 1998 shown in the sources and uses of funds statement, the IRR calculation can be made on your I-phone. You divide \$30 billion by \$250 million and then raise the result to the number of years between 2015 and 1998 minus 1. This number that does not account for cash flow earned by Conoco from 1998 through 2007 results in a CAGR or IRR of 32.5%. It demonstrates just how much is generated from a high IRR. If the IRR were 10% and the investment were \$250 million, the one-time cash flow at the end of the period would be \$1.275 billion instead of \$30 billion. The example demonstrates that numbers are dramatic and become so big that they are practically meaningless when IRR's are high. The mathematics of why high IRR's are not useful in measuring value are discussed in Chapter \_\_\_\_ of Part 3.

When the cash flows occur in intervening periods instead of all at the end of the project, interpretation of the IRR statistic becomes a lot more difficult. A

question that was raised by a lawyer a few years ago was what is all this business about IRR anyway. The question is not so easy to answer, especially when the IRR is high and there are continuing cash flows. With high cash flows generated soon after the investment is made, the IRR is high even if no future cash flow goes into the pocket of equity holders. In these cases the future cash flows seem to make no difference at all in the IRR calculation. For the Petrozuata data presented in the HBS case where nominal oil prices do not increase above \$18.64 per barrel more cash flow accrues to the project at the end of the project than at the beginning of the project in the numbers presented in the HBS case. Even though out year cash flows are high, the IRR does not change with future cash flows. Figure 3.5 displays the IRR where cash flows after various dates are ignored and assumed not to be given to equity investors after various end dates. The graph shows the IRR has virtually no change after year 2009. However, nominal cash flows after 2009 are even more than the cash flows before 2009. In business school you can try to explain away why this is reasonable. The result does not make sense. Chapter \_\_\_\_ of Part 3 explains the mathematics of the IRR and why results like this that do not make sense occur. A video on the associated website [www.edbodmer.com](http://www.edbodmer.com) demonstrates how to create this analysis from data presented in the HBS case.

#### INSERT GRAPH OF IRR AT DIFFERENT EXIT DATES

After the project begins operation, the risk changes a lot, just like the risk of a relationship failure changes after the wedding date. The remaining risk other than political risk for Petrozuata was the oil price. In theory the oil price could be hedged with a forward contract reducing the risk to virtually a risk free project. The project could then be sold to another company and where the buying company should not have a return much higher than the risk free rate. Using futures markets together with low discount rates is discussed in the arbitrage pricing chapter in Part 2. Even if the risk free rate is not used by a prospective buyer, the required return should be a lot lower after the construction period. Assuming the project would be sold where the new buyer would accept a return of 12% produces a maximum IRR of \_\_\_\_% rather than the 25.6% mentioned at the beginning of the section. Figure 3.6 shows different IRR's that result from different sale dates and buyer discount rates. Reasons for the IRR's being different with different sale dates is explained in Part 3. The point of Figure 3.6 is to demonstrate that when it comes to IRR's you can take your pick. Figure 3.6 also confirms that when the IRR is very high, the number is ambiguous as the variation in IRR's is greater.

#### INSERT GRAPH OF IRR AT DIFFERENT SALE DATES WITH DIFFERENT BUYER IRR's.

To see what an IRR of 25% means, you can compare the amount of money that you make from that IRR with the IRR you would make by investing at the risk free rate. The additional money you make is the risk premium. This risk premium can be discounted to the date of the investment and compared to the size of the investment. You can think of the risk premium measured in this way as follows. Assume that you make the equity investment of \$250 million in a risk free investment. Then, you trade the amount of money you make from the risk free investment with an investment in Petrozuata. You will get the risk free investment as long as things work out, but you ask to be paid for taking the added risk. For Petrozuata, this risk premium is very high as shown in Figure 3.7. The IRR of 25% may not sound like it is that high. But when this return is compared to what you could earn with the risk free rate, the earned risk premium relative to the initial investment is dramatic. The valuation lesson is that the IRR is not a reasonable measure of economic profit when the numbers are big. As an investor, you can ask for this type of high IRR, but it is very difficult to earn this kind of money over a long period without taking very big risks. As with other issues, this technique is discussed. At the very low oil prices assumed in the case, the investment made in 1998 is fully paid back after \_\_\_ years of operation in \_\_\_\_\_. For MBA students, this payback analysis would be immediately dismissed because it does not account for cost of money or risk. But it may tell more about the profitability of the project than the IRR. If your money is paid back in a couple of years at a low oil price and the rest is upside, the investment is very profitable. You don't need much more.

Pretending that the company would receive this money in 2015 and However does not tell the story. As explained in Chapter \_\_, the equity IRR is particularly misleading when it is high and when the project is long with many intermediate cash flows. An alternative to computing the equity IRR is a bit more complex but involves explicitly evaluating how much is earned over and above the risk free rate. This can be compared to the amount spent on the investment.

#### GRAPH OF IRR AND EARNED RISK PREMIUM AS A PERCENT OF THE PROJECT COST WITH DIFFERENT TIME PERIODS

No real downside risk in the price of oil. But with upside the amount extracted from the country is much higher. Only risk is oil price risk and not much real chance of downside.

# Valuation Flaw 3: Expecting to Earn High Returns on Off-Shore Investments and Taking Political Risk

One of the most difficult parts of the HBS case to read is the discussion of the cost of capital. When people working with real transactions see discussion of ungeared beta, the equity risk premium, country risk premiums and a start-up premium, they gloss over the numbers as gobblety gook and ask about the IRR. The fact that an equity cost of capital of 21% is derived and this is close to the earned IRR demonstrates nothing other than, when it comes to cost of capital, you can use the CAPM to come up with any number that you want. Part 2 of the book explains many of the biases inherent in the CAPM and why the model is not useful in measuring the value of a project. The blunder in valuation analysis that is the focus of this discussion is the risk premium for country risk that is generally for various companies around the world. When the country risk premium is high for a country, the increased cost of capital either makes projects very expensive for people living in the country (see Chapter 5 for the Dahbol case) or it makes investors take the economic rents from resource projects out of a country. Either situation leads to a vicious circle where the high cost of capital creates political problems which in turn aggravate the political risk.

Absurdity of 7% risk premium. Incorrect capital structure. Start-up risk premium taken from the air. All discussed in Part 2. This concentrates on the country risk premium.

Viscous circle of country risk premium.

Probability of default and risk premium.

The instructor should begin by asking students what they think of the cost of capital methodology used by the Petrozuata planning team (case **Exhibit 11**). Students are likely to raise several concerns with the methodology. The first issue is the choice of comparable firms used to estimate Petrozuata's asset beta ( $\beta_A$ ). Does it make sense to use US oil refineries given that Petrozuata is an integrated firm comprised of three segments: a refinery, a pipeline, and an oil field? A larger and broader sample would probably yield a better estimate. In fact, the assignment questions provide an asset beta of 0.60 estimated using data on the publicly traded integrated oil companies appearing case **Exhibit 8**.

$$K_E = R_f + \beta_E (R_M - R_f) + SP + CP$$

- ◆ Petrozuata's equity beta ( $\beta_E$ ) is **0.94** which is estimated by relevering the average asset beta ( $\beta_A=0.38$ ) from a sample of four US oil refineries (Ashland, Tosco, Ultramar, and Valero Energy) assuming a capital structure with 60% debt.
- ◆ Based on average data from 1926 to 1994:
  - The current 7.00% yield on long-term US Treasury bonds less a 1.4% liquidity premium is a proxy for the risk-free rate (**5.60%** = 7.00%-1.40%). The 1.4% represents the average premium of long-term Treasury bonds over short-term Treasury bills.
  - A **7.0%** risk premium is generally used. The premium is based on the average returns of large company stocks less the returns of long-term Treasury bonds.
  - The equity market risk premium for start-up companies has averaged **2.1%**.
- ◆ The approximate spread of Venezuelan Eurobonds over US Treasury bonds (1000 basis points) would generally be used to determine the country risk premium. Actually, this spread should be considered the upper bound for political risk because the probability of expropriation of a local project is lower than the default risk of a developing country's Government bond. The premium can be scaled down under circumstances specific to a particular operating situation. In this case, an appropriate country risk premium for Petrozuata is two-thirds of that, or **667 basis points**, especially given the export nature of the project and its US dollar revenues.

$$\beta_{\text{Venezuelan Project}} = \beta_{\text{US project}} * \beta_{\text{Venezuelan Country Beta.}}$$

$$\beta_{\text{Venezuelan Country Beta}} = \rho_{\text{Venezuela/US}} * (\sigma_{\text{Venezuela}} / \sigma_{\text{US}}),$$

$\rho_{\text{Venezuela/US}}$  = correlation between Venezuelan and US markets, and

$\sigma_{\text{Venezuela}}$  = volatility of the Venezuelan market.

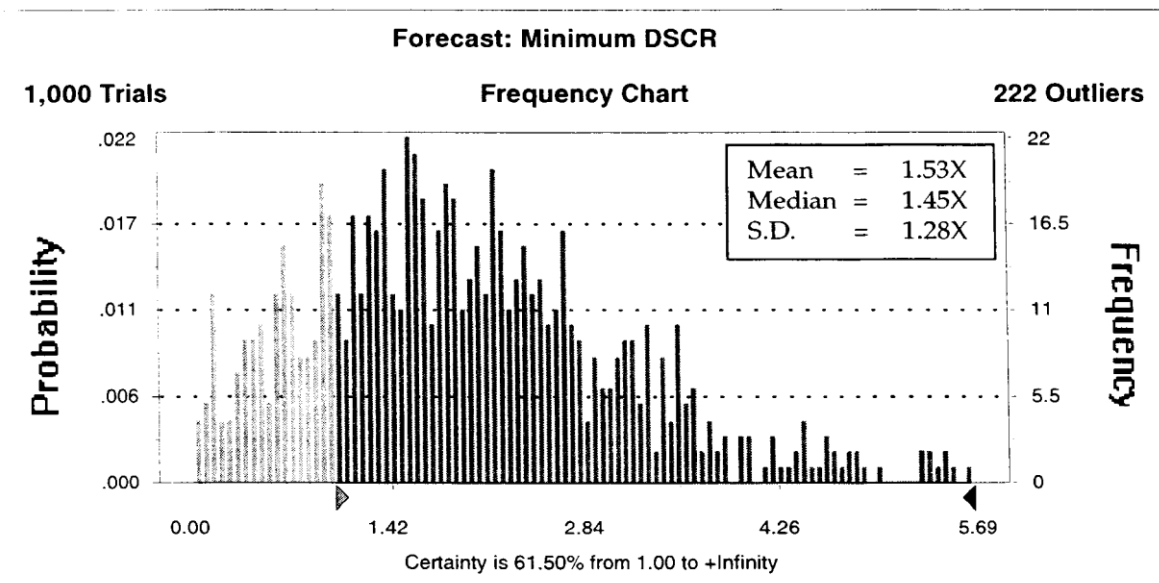
$\sigma_{\text{US}}$  = volatility of the US market

Just about all of the valuation errors noted above factored into the mother of all valuation nightmares – the global financial crisis precipitated by declines in the U.S. housing loans known as the sub-prime crisis. Very many books, films and articles have explained the crisis and the discussion below is not intended to be

#### GRAPH OF IMPLIED PROBABILITY OF NATIONALIZATION IN DIFFERENT CREDIT SPREADS



# Valuation Issue 4: Upside Potential, Downside Risk and Inappropriate Use of Monte Carlo in Evaluating the Project



Teaching note had Monte Carlo. Makes pretty graph and looks sophisticated. But does not address any real issue in the case, and how the case can be used with crystal ball or at risk to construct Monte Carlo simulation. Uses a volatility of 20% and a trend of 2.5%. Results in many cases that have oil prices of below \$\_\_.

The bond financing originally was planned to be US\$650 million, but it was later raised to US\$1 billion after indications of investor interest. The commercial loan portion of the financing was scaled back proportionally. Because of favorable response in bond market, raised more than expected from banks and used \$450 million in bank debt.